# Washington State University Energy Program
# Final Report
## Geothermal Direct Use - Contract DE-FG07-99ID13828
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The third year of the program saw a significant reduction in funding due to budget problems at the Department of Energy. Because of the budget reduction WSUEP was forced to reduce the number of new cities/projects that would be evaluated (see attached) to a minimum and instead concentrate more on follow-up work with sites with whom we had already worked. We also continued to take advantage of lessons learned in using HEATMAP/GEO and with funding not provided by this contract, but rather with funding from NREL and our partners in Denmark, Seven Technologies. In so doing, we have made a number of significant changes to the program that should make it substantially easier to use. These changes involve the replacement of the need for AutoCAD as the graphic interface with Model Manager that allows for use of most CAD and GIS systems. We have also incorporated a new hydraulic engineer for distribution system analysis. We have also added CHP capability to the program so that combined heat and power projects can be easily modeled. Finally we have integrated HEATMAP and TERMIS. TERMIS is designed for online and real time operation of district energy systems. The integration will provide project developers with a single suite of models that allows for feasibility studies, design, and operation. The new model will be made available to any of the projects which we have previously worked should they decide to move forward with project studies or project implementation. WSUEP has continued to work with Elko, Nevada and Boise, Idaho, and we have provided HEATMAP analysis of Cascade and Lava Hot Springs to the Idaho Energy Office and Elko to NREL. We have also had several discussions relative to ongoing interest in Mammoth, California where they have now formed an energy working group to continue to pursue development of a geothermal district energy system. We have also continued to meet with Boise, Idaho city staff. However, due to continued reservoir concerns, expansion of the project as was initially planned has once again been put on hold.

Our work in this third year with the University of Nevada, Reno has been plagued with problems related to the transfer of ownership of the power plant(s), the ATS facility to ORMAT and the Caithness Steamboat facility also to ORMAT. Copies of HEATMAP are being provided to both the University and to ORMAT. Our work with the city of Wells, Nevada unfortunately did not progress beyond the visit we had with the city, utility, and consultants. A copy of HEATMAP is being provided to the consulting firm working with the city of Wells.

Conclusion:.

The program already demonstrated the interest in pursuing geothermal district energy development. All of the projects with which we worked provided excellent help and in most instances very good data.

The training sessions in the use of HEATMAP were extremely beneficial and our ability to hold them at the GeoHeat Center of the Oregon Institute of Technology provided the opportunity to visit the geothermal district heating systems that serve the Institute and commercial business district of Klamath Falls. Such tours are crucial to the understanding of what a geothermal district heating system can mean to a community or institution.

The tremendous power of HEATMAP/GEO to quantify and cost effectively complete geothermal district heating system feasibility studies was well demonstrated, and lessons learned through conducting feasibility studies in a wide range of communities with very different levels of internal capability have resulted in major changes to the program to improve its flexibility and to greatly improve its "user friendliness". The elimination of the need for AutoCAD, the addition of CHP capability, and the integration with TERMIS now allows HEATMAP to be used for feasibility studies, design, and with TERMIS real time system operation.

But there were a number of problems encountered. First, few of the communities have the internal capability to fully pursue geothermal district heating development. All of those with which we worked would need outside consulting assistance even to continue work relative to feasibility studies. Second, most of the communities do not have the financial resource needed to retain such consultants without outside assistance. Third, few of the communities have adequate resource information except for those where some development has occurred. The lack of resource information serves as a serious impediment to development. There is a need to provide programs that help with resource assessment, and especially with confirmation drilling.

It is our recommendation that serious consideration be given to the re-establishment of such programs as the POU, EWESA and reservoir confirmation program. It is also recommended that a SWAT team be established to assist communities pursuing development. Such a team should have experts in resource assessment, drilling, legal, and institutional analysis, environmental permitting, design, construction, and financing. Such a team would, however, only be beneficial if some of the afore-mentioned programs were made available.

There are many potentially highly attractive geothermal district heating projects that could add substantially to our use of geothermal energy. We hope that the needed programs can be put into place to realize this potential.

The second year of the program was similar, but with a few major differences. First, we did not feel that it was necessary to bring the state teams together a second time as little additional geothermal exploration was ongoing and we already had a strong list of communities with which to work. Second, few changes were required to the HEATMAP© model. We did, however, decide to change the AutoCAD interface so that it would be much more user friendly and thus more likely to be used by the communities. The entire AutoCAD interface is now written in visual basic and is a major improvement. Although not requiring DOE funding, additional changes to the program have been made

that benefit the overall usefulness of the program. These changes were made as a result of funding made available by the US Army Corps of Engineers. Additional changes are presently under way that will allow other Cad and GIS systems to be used as well as Auto CAD. This work is also a result of funding provided by US army corps of engineers. During the course of the second year we worked with eight sites including two Indian reservations. A training session was once again held on the campus of the Oregon Institute of Technology in early September and once again included tours of the operating geothermal district energy systems

And funding for year 3 was reduced to $30,000. We have thus been forced to scale the project back to two additional communities and these will be selected and work begun in the April/May time frame. The entire project is slated for completing in September 2002.

We have, for example, worked with Elko, Nevada where there are plans to double the size of the system and in Boise, Idaho where considerable growth is expected as a result of the lifting of the moratorium on additional resource use. Not every site that we have evaluated has either the technical or economic potential for district energy due to either heat load density limitations or political realities. What I can say is that the type of analysis that we have provided is a major step in encouraging communities to move forward. It is never enough to merely know that there is a geothermal resource nearby; the real question is can that resource be technically and economically put to beneficial use. There have been, however, a few lessons learned and I hope that they will be put to good use. First, additional work must be done with the community political leadership to better understand what may or may not be politically feasible, and to ensure that support that is required to do a sufficiently detailed analysis is provided to make the results truly meaningful. Second, the analysis must be done in the manner consistent with the decision making process in the community so that the information is presentable in a manner that is fully understandable and easily evaluated. Third, there is a tremendous need for a strong technical assistance program that can continue to provide needed assistance once the original HEATMAP© analysis is completed. I believe that the latest NREL solicitation for technical assistance will provide that missing critical tool. Fourth, I believe that we were overly ambitious in our original proposal and I believe six to eight communities is really all that should be attempted in one year to allow adequate time to develop the information and relationship with the community that is desired.

The first year of the program involved a number of activities leading to the completion of the geothermal module for HEATMAP©, testing the model and the using the model to evaluate the technical and economic viability of six communities. There were a number of steps that were taken prior to our getting out into the field to undertake completing the HEATMAP© runs. We began with a thorough evaluation of the potential need of communities and how the geothermal module of HEATMAP© should be best structured to meet those needs. We also needed to make sure that the model would be as usable as possible by the staffs of the communities, or if they so choose, their consultants. Based on this evaluation we began to make the programming changes and complete the geothermal well field production module. Other changes to the program included work on the economic routines to allow for a more complete life cycle cost analysis in addition to the

minimum revenue requirement model that was originally in the program. This involved revising the RELCOST module originally developed by WSEO. This included converting the program for IBM Basic to Visual Basic and adding a number of new features to improve user selections. Once the programming changes were well underway we organized two meetings in Salt Lake City, Utah where we brought together all of the state geothermal teams together with the geothermal team (name of organization) at the University of Utah. The staff of the Geo-Heat Center and one consultant with extensive knowledge of geothermal resource sites through the western US. Each of the sessions were two day sin length and resulted in a short list of high potential sites co-located with communities that could possibly support a geothermal district energy system. Sites were identified throughout the west and some consideration was given to including military bases and Indian reservations, or Pueblos. Once the list was established we issued an RFP designed to identify cities that were interested and that would commit the needed personnel to assist us with our work. Six entities were selected including four communities, a military base and an Indian Pueblo. The six sites were all visited for purses of data collection and each of the sites were loaded on HEATMAP© for evaluation. Once the work was completed a course was organized at the Oregon Institute of Technology Campus and representatives of each of the sites was invited to attend a training course on the use of HEATMAP© and was afforded the opportunity to tour the college's district heating as well as the downtown system. Each of the sites was then provided with the fully loaded copy of HEATMAP© so that further analysis could be undertaken. A number of the projects that were assisted subsequently applied for assistance under the NREL direct use solicitation and two others indicated that they would be at a point where they would apply if such a solicitation were issued in the future.